



## Original Articles

## Drawn together: When motor representations ground joint actions



Francesco della Gatta<sup>a</sup>, Francesca Garbarini<sup>b</sup>, Marco Rabuffetti<sup>c</sup>, Luca Viganò<sup>a</sup>, Stephen A. Butterfill<sup>d</sup>, Corrado Sinigaglia<sup>a,e,\*</sup>

<sup>a</sup> Department of Philosophy, University of Milan, via Festa del Perdono 7, I-20122 Milano, Italy

<sup>b</sup> Department of Psychology, University of Turin, via Po 14, I-10123 Milano, Italy

<sup>c</sup> Department of Biomedical Technology, IRCCS Don Carlo Gnocchi Foundation Milan, Italy

<sup>d</sup> Department of Philosophy, University of Warwick, Coventry, CV4 7AL, UK

<sup>e</sup> Center for the Study of Social Action, University of Milan, Italy

## ARTICLE INFO

## Article history:

Received 29 June 2016

Revised 14 April 2017

Accepted 24 April 2017

Available online 11 May 2017

## Keywords:

Joint action

Collective goal

Motor representation

Interpersonal coupling

## ABSTRACT

What enables individuals to act together? Recent discoveries suggest that a variety of mechanisms are involved. But something fundamental is yet to be investigated. In joint action, agents represent a collective goal, or so it is often assumed. But how, if at all, are collective goals represented in joint action and how do such representations impact performance? To investigate this question we adapted a bimanual paradigm, the circle-line drawing paradigm, to contrast two agents acting in parallel with two agents performing a joint action. Participants were required to draw lines or circles while observing circles or lines being drawn. The findings indicate that interpersonal motor coupling may occur in joint but not parallel action. This suggests that participants in joint actions can represent collective goals motorically.

© 2017 Elsevier B.V. All rights reserved.

## 1. Introduction

What enables individuals to act together? People walk, play games and draw together. Joint actions such as these are thought to involve a variety of mechanisms (Knoblich, Butterfill, & Sebanz, 2011). For instance, walking together, as well as joint actions involving music or dance, may be achieved in part thanks to entrainment, the process of synchronizing two or more rhythmic behaviours with respect to phase (Nessler & Gilliland, 2009). Entrainment can occur without any intention to coordinate (Varlet, Bucci, Richardson, & Schmidt, 2015) or even despite individuals attempting not to coordinate their actions (Issartel, Marin, & Cadopi, 2007; Ulzen et al., 2008).

Nonrhythmic joint actions can be coordinated by representations concerning others' tasks which can modulate performance of one's own task, facilitating or impairing it (Sebanz, Knoblich, & Prinz, 2003, 2005). For instance, which flankers distract a subject can depend not only on her own task but also on her co-actor's task (Atmaca, Sebanz, & Knoblich, 2011). Likewise, how stimuli such as words are processed can also depend on their relevance to a co-actor's task (Baus et al., 2014). Many joint actions have rhythmic and nonrhythmic aspects; coordination of such actions may

involve both entrainment and representations concerning others' tasks (van der Wel & Fu, 2015).

While these mechanisms are plausibly critical for enabling individuals to act together, something fundamental is missing from this picture of joint action. In joint action, agents represent not only each individual's tasks but also a collective goal; or so it is often held (Bratman, 2014; Searle, 1990; Vesper, Butterfill, Knoblich, & Sebanz, 2010). A *collective goal* is an outcome to which two or more actions are directed where this is not, or not only, a matter of each action individually being directed to that outcome (Butterfill, 2016). But how, if at all, are collective goals represented in joint action? And, if they are, how do such representations impact performance in joint action? To date little research has directly addressed these questions. The aim of the present paper is to begin filling this gap.

Previous findings indicate that in joint actions such as playing a piano duet, clinking glasses, jumping together and moving an object, agents' motor representations and processes take into account relations between their own actions and others' in preparing and monitoring their actions (Kourtis, Knoblich, Wozniak, & Sebanz, 2014; Loehr et al., 2013; Meyer, van der Wel, & Hunnius, 2013; Tsai, Sebanz, & Knoblich, 2011; Vesper, van der Wel, Knoblich, & Sebanz, 2013). These findings motivated us to conjecture that participants in joint actions can represent collective goals motorically. Because representing a collective goal (or any goal) triggers motor processes concerning actions that should bring the

\* Corresponding author at: Department of Philosophy, University of Milan, via Festa del Perdono 7, I-20122 Milano, Italy.

E-mail address: [corrado.sinigaglia@unimi.it](mailto:corrado.sinigaglia@unimi.it) (C. Sinigaglia).

goal about, representing a collective goal would mean that in each participant there are motor processes concerning not only actions she will perform but also actions another will perform. This could facilitate prediction of, and coordination with, another's actions; but it could also create interference.

One recent challenge in joint action research concerns to what extent agents really do take into account relations between their own actions and others'. In a series of experiments, [Dolk et al. \(2011\)](#), [Dolk, Hommel, Prinz, and Liepelt \(2013, 2014\)](#) have proposed that effects which appear to be specific to joint action are actually merely a consequence of mechanisms for distinguishing one's own actions from other events (see further [Dittrich, Bossert, Rothe-Wulf, & Klauer, 2017](#); [Wenke et al., 2011](#)). On this account, what matters are relations between one's own actions and other events rather than between one's own actions and a co-actor's actions. While this alternative account is unlikely to explain the full range of existing findings as it stands (e.g. [Baus et al., 2014](#); [Kourtis, Sebanz, & Knoblich, 2013](#)), it would be useful to have a direct approach to testing the conjecture that participants in joint actions can represent collective goals motorically.

Testing this conjecture requires a pair of situations which differ in that one involves a collective goal whereas the other does not. To create such a pair, we need to deviate from prior studies. These typically compare one person acting with two people acting. But to move from one to two agents is not necessarily to move from individual to collective goals. After all, two people creating graffiti in an underpass may merely happen to be drawing alongside each other, so that their actions are parallel but merely individual: this need not involve any collective goal. We therefore seek a pair of minimally different situations which contrast acting in parallel but merely individually with acting jointly.

To create such a pair of situations we adapted a bimanual paradigm, the circle-line drawing paradigm, which has been extensively employed for investigating bimanual interference ([Franz, Zelaznik, & McCabe, 1991](#)). When people have to simultaneously perform incongruent movements, such as drawing lines with one hand while drawing circles with the other hand, each movement interferes with the other and line trajectories tend to become ovalized. This "ovalization" has been described as a bimanual coupling effect, suggesting that motor representations for drawing circles can affect motor representations for drawing lines ([Garbarini & Pia 2013](#); [Garbarini, Rabuffetti, Piedimonte, Solito, & Berti 2015b](#); [Garbarini et al. 2012, 2013a, 2015a](#); [Piedimonte, Garbarini, Rabuffetti, Pia, & Berti 2014](#)). Importantly, merely observing another drawing a circle while drawing a line oneself does not typically result in ovalization and there are no indicators of interpersonal coupling between mere observers drawing in parallel ([Garbarini et al., 2013b, 2016](#)). Our question was therefore what happens when two people are acting together rather than merely in parallel. Would this result in ovalization indicative of interpersonal coupling?

To answer this question we modified the circle-line drawing paradigm. Participants were first asked to act bimanually by continuously drawing lines with the right hand and lines or circles with the left hand. This bimanual task was taken as a baseline measurement in order to rule out subjective differences in bimanual coupling, which could have an influence on the experimental manipulation. Participants were then asked to act unimanually by drawing either circles or lines with their right hands while observing either lines or circles being unimanually drawn by an experimenter playing the role of a confederate ([Garbarini et al., 2013b, 2016](#)). We contrasted a Parallel Action condition with a Joint Action condition. These conditions differed only in the instructions given. In the Joint Action condition participants were instructed to perform the task together with the confederate, as if their two drawing hands gave shape to a single design. In the

Parallel Action condition, participants were given no such instruction so that they could draw in parallel, observing each other but not acting together. If participants were to follow our instructions, their actions would have the collective goal of drawing a circle and a line in the Joint Action condition but not in the Parallel Action condition. If the collective goal were represented motorically in the Joint Action condition, then, from the point of view of each participant's motor system, it would be almost as if she were representing the whole action bimanually. Accordingly, we predicted that there should be an interpersonal motor coupling effect. This would result in greater ovalization of the lines drawn in the Joint Action condition than in the Parallel Action condition.

Although producing designs involving simple circle and line drawings may appear far from the sorts of joint action that matter in everyday life, the paradigm we shall use is nothing but a simplified version of what artists are doing when they unite to create joint works. And this is but one example of the myriad, and mostly more mundane ways in which performing joint actions enables us to create and do things none of us could achieve alone. In testing the hypothesis that participants in joint actions can represent collective goals motorically, we aim to understand something about what makes joint action possible.

## 2. Method

### 2.1. Participants

Thirty-six healthy graduate and undergraduate volunteer students from the University of Milan took part in the experiment (16 males and 20 females; mean age  $\pm$  sd:  $25 \pm 3$  years; mean educational level: 15 years). All participants were naïve to the purpose of the study and screened to exclude a family history of psychiatric, neurological or medical disease. All of them gave informed consent before the experiment in accordance with the ethical standards of the 1964 Declaration of Helsinki.

### 2.2. Experimental design

All participants (36) first completed a bimanual baseline experiment. In this experiment, participants individually took part in a version of the standard bimanual circle-line drawing paradigm ([Franz et al., 1991](#)) with the following two tasks:

1. Congruent bimanual lines-lines (B-LL): participants were asked to simultaneously draw lines with both hands.
2. Incongruent bimanual circles-lines (B-CL): participants were asked to simultaneously draw lines with the right hand and circles with the left hand.

In both tasks, participants drew on two digitizer tablets, one for each hand, while observing a cross presented on the computer screen ([Fig. 1A](#)). The experimenter specified online what they had to draw, either lines with both hands (B-LL task) or circles with the left hand and lines with the right hand (B-CL task). The drawing tasks were presented in a random order. Participants completed twenty trials (10 for each task) with 4 s of rest between each trial; this took around 6 min in total.

For the unimanual main experiment, all female (20) and male subjects (16) were randomly assigned to one of two experimental conditions, either the Parallel Action condition or the Joint Action condition (18 participants for each group, 8 males and 10 females). In both conditions, participants performed four unimanual drawing tasks with a confederate (who was one of the experimenters):

Download English Version:

<https://daneshyari.com/en/article/5041503>

Download Persian Version:

<https://daneshyari.com/article/5041503>

[Daneshyari.com](https://daneshyari.com)